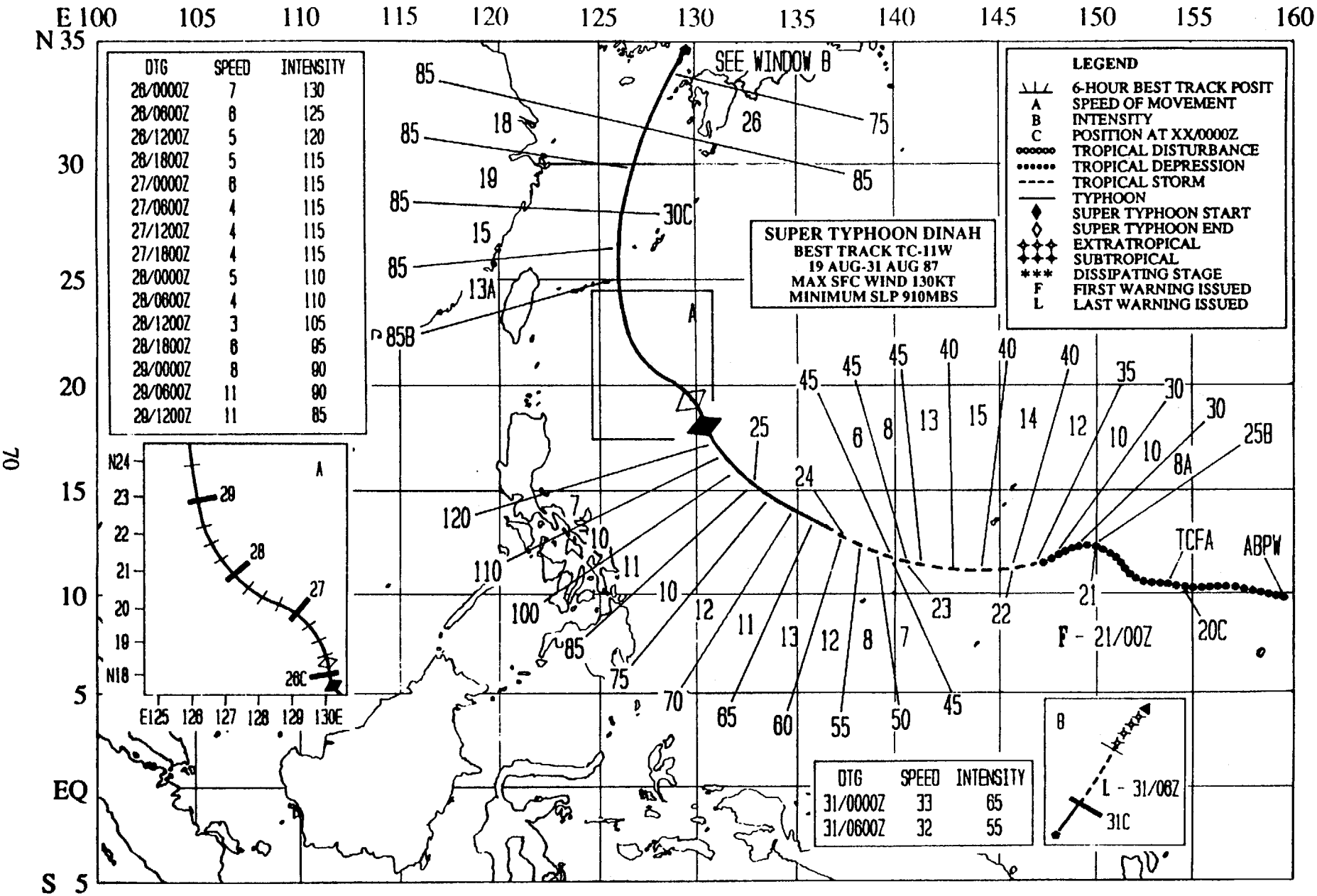

SUPER TYPHOON DINAH
BEST TRACK TC-11W
19 AUG-31 AUG 87
MAX SFC WIND 130KT
MINIMUM SLP 910MBS
LEGEND
6-HOUR BEST TRACK POSIT
A SPEED OF MOVEMENT
B INTENSITY
C POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
*** DISSIPATING STAGE
F FIRST WARNING ISSUED
L LAST WARNING ISSUED
DTG SPEED INTENSITY
28/0000Z 7 130
28/0600Z 8 125
28/1200Z 5 120
28/1800Z 5 115
27/0000Z 8 115
27/0600Z 4 115
27/1200Z 4 115
27/1800Z 4 115
28/0000Z 5 110
28/0600Z 4 110
28/1200Z 3 105
28/1800Z 8 95
29/0000Z 8 90
29/0600Z 11 90
29/1200Z 11 85
DTG SPEED INTENSITY
31/0000Z 33 65
31/0600Z 32 55
SEE WINDOW B
TCFA
ABPW
F - 21/00Z
L - 31/06Z
E 100 105 110 115 120 125 130 135 140 145 150 155 160
N 35 30 25 20 15 10 5 EQ S 5
70
E125 126 127 128 129 130E
N24 23 22 21 20 19 N18

SUPER TYPHOON DINAH (11W)

Super Typhoon Dinah (11W), the most destructive typhoon to strike Okinawa and the southern islands of Japan in the past 20 years, caused extensive damage to both Japanese civilian properties and U.S. military bases and assets.

Dinah was first observed on satellite imagery as a disorganized cluster of weak convection in the near-equatorial trough on 18 August. By the 19th, convection became better organized and the disturbance was noted on the Significant Tropical Weather Advisory (ABPW PGTW) issued at 190600Z. During the next eighteen hours, Dinah developed a low-level circulation as it passed northwest of the island of Pohnpei and moved beneath moderate directional and speed divergence at the 200 mb level. The 200000Z satellite imagery indicated weak convective curvature and, as a result, a Tropical Cyclone Formation Alert was issued at 200427Z. During the next eighteen hours, satellite imagery indicated a considerable increase in convection which had become more centralized (see Figure 3-11-1). The system was assigned a Dvorak intensity number ("T-number") of 2.0 which corresponded to maximum sustained surface winds of 30 kt (15

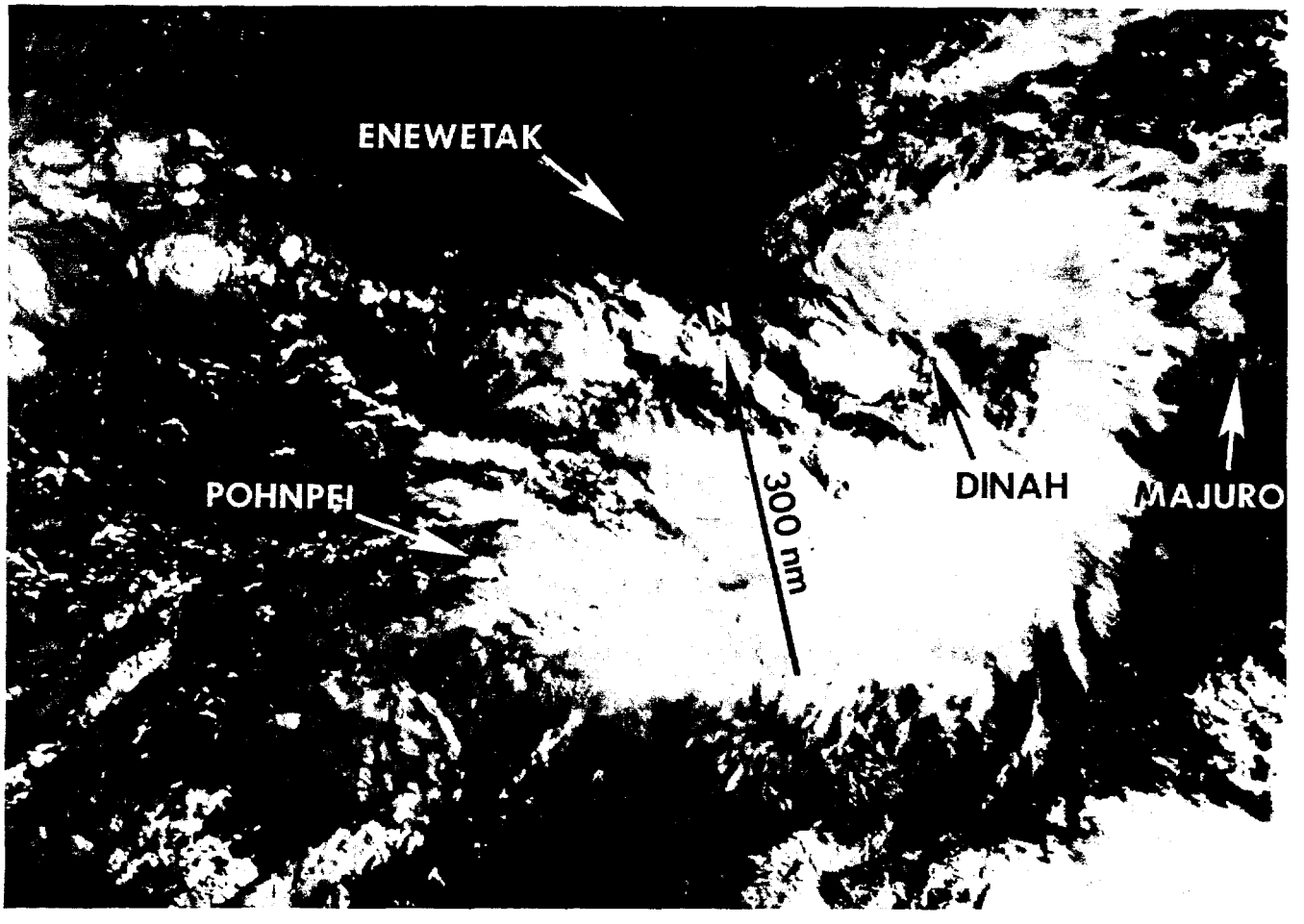


Figure 3-11-1. The initial development of Super Typhoon Dinah was first noted as a considerable increase in the amount of convection (202102Z August NOAA visual imagery).

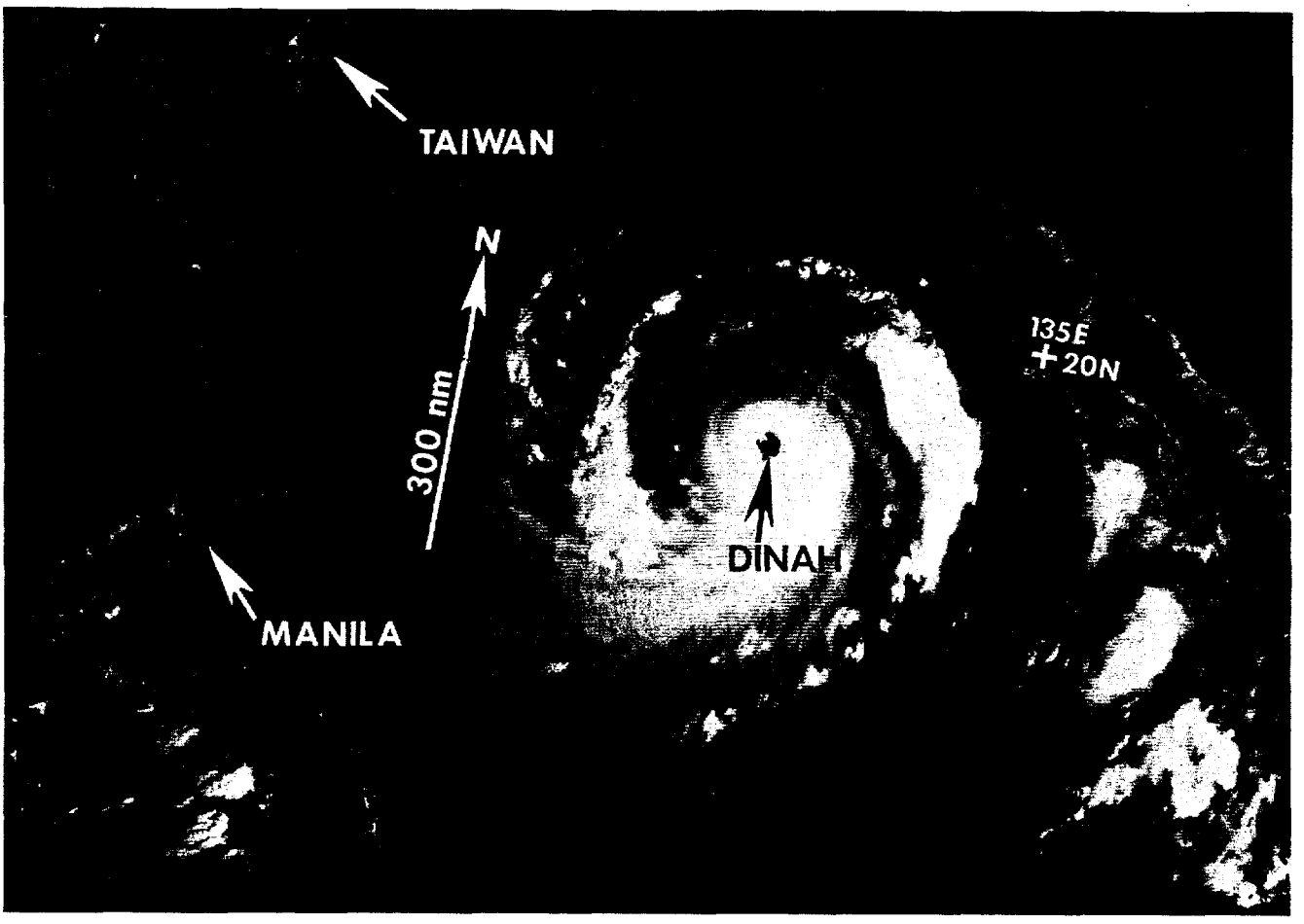


Figure 3-11-2. Super Typhoon Dinah in the Philippine Sea near maximum intensity (260054Z August DMSP visual imagery).

m/sec) and an estimated MSLP of 1000 mb. At 210000Z, the first warning was issued on Tropical Depression 11W when it was located 300 nm (556 km) east-southeast of Guam.

Between 210000Z and 211800Z, Tropical Depression 11W assumed a more westward track in response to the strengthening subtropical ridge to the north and moved beneath an upper-level anticyclone which had associated strong speed divergence southwest of the system. The increased outflow signature on satellite imagery allowed for a Dvorak intensity estimate of 35 kt (18 m/sec). Based on this estimation, Tropical Depression 11W was upgraded to Tropical Storm Dinah (11W) at 211800Z.

Over the next forty-eight hours, Dinah moved westward passing 120 nm (222 km) south of Guam at 220300Z with maximum sustained surface winds estimated at 40 kt (21 m/sec). Dinah did not intensify at the normal rate of one "T-number" per day. This was apparently due to 45 kt (23 m/sec) 200 mb winds over the cyclone which created an undesirable shearing environment. However, by 240000Z, Dinah had moved away from this unfavorable shearing environment and developed a good anticyclonic outflow pattern which was visible on satellite imagery. The 241200Z 200 mb streamline analysis confirmed this and indicated a good cyclonic outdraft directly over Dinah's center which became anticyclonic as it moved radially outward from

the center. During the first half of this period, Dinah tracked westward and then gradually turned more toward the west-northwest. JTWC forecasts correctly predicted the system's motion which was supported by the dynamic One-Way Interactive Tropical Cyclone Model (OTCM).

A Dvorak intensity analysis of satellite imagery at 240300Z estimated maximum sustained surface winds of 65 kt (33 m/sec) and an estimated MSLP of 980 mb. On the 240600Z warning, Tropical Storm Dinah was upgraded to typhoon status. At that time it was located 500 nm (926 km) west of Guam. Between 240600Z and 250600Z, Typhoon Dinah's outflow continued to increase with some restriction northwest through northeast of the cyclone which was associated with weak short-wave troughs passing to the north. However, those minor restrictions did not inhibit Dinah from continuing to intensify at the normal Dvorak rate.

During the next twenty-four hours, Typhoon Dinah's intensity increased at a rate much faster than the normal one "T-number" per day and by 260000Z it reached super typhoon intensity (130 kt or 67 m/sec) at a location 500 nm (926 km) east of northern Luzon (see Figure 3-11-2). Dinah remained at super typhoon intensity for only a few hours but maintained maximum sustained surface winds of 110 kt (57 m/sec) or greater until 280600Z.

From 240600Z until 281200Z, Dinah basically tracked toward the northwest at an average forward speed of 11 kt (20 km/hr)

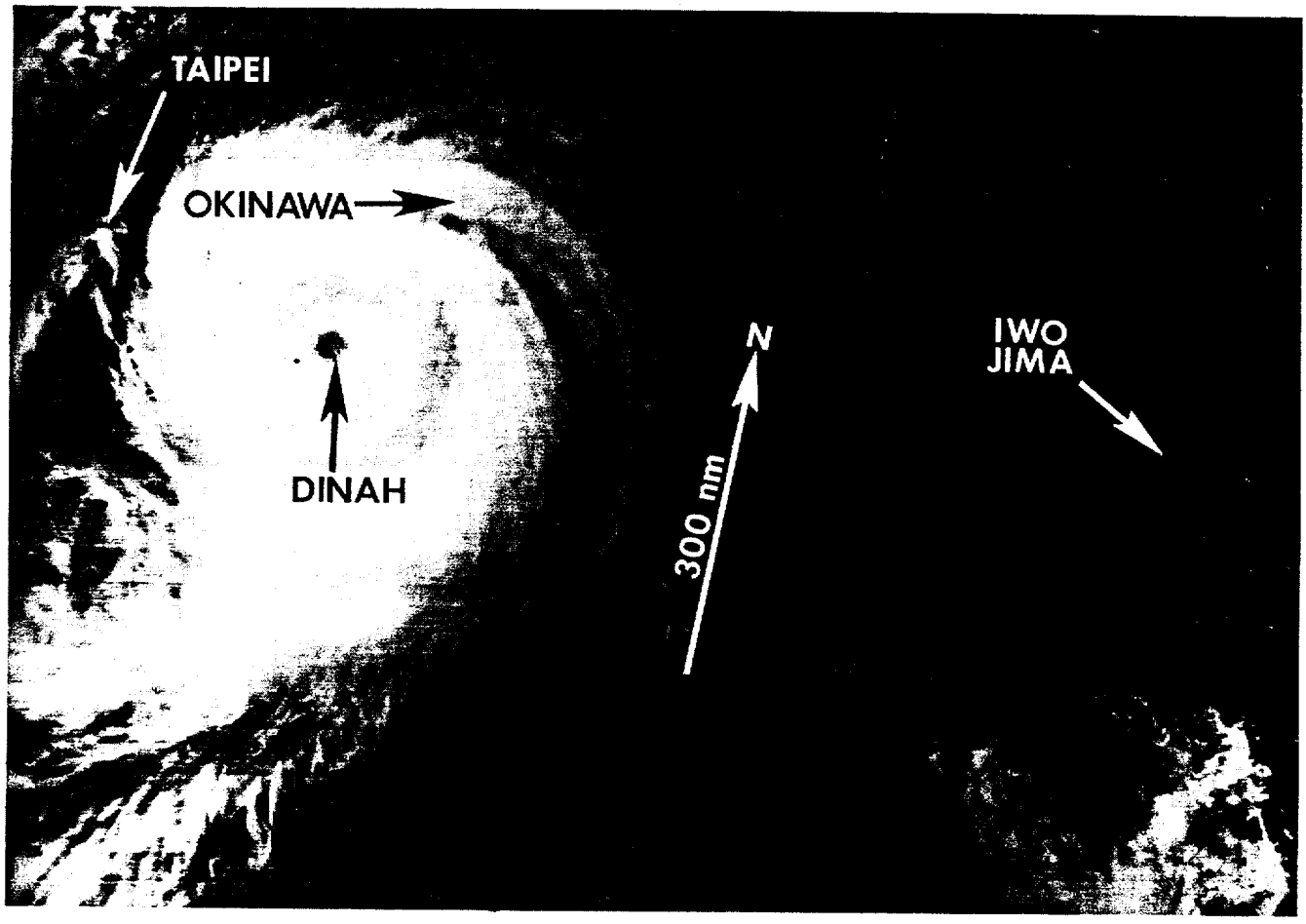


Figure 3-11-3. Dinah during its dissipating stage passing to the west of Okinawa, Japan (290605Z August NOAA visual imagery).

during the first twenty-four hour period, slowing to an average of 6 kt (11 km/hr) by 251800Z. The slower forward speed is typical of a very well-developed and very intense tropical cyclone as it approaches the axis of the subtropical ridge prior to recurvature.

After 281200Z, Typhoon Dinah made a turn toward a more northerly track as it moved around the western periphery of the subtropical high. During the next thirty-six hours, Dinah moved into unfavorable upper-level conditions in the form of impinging mid-level short-wave troughs moving northeastward across eastern China and Japan. As each short-wave trough passed north of Dinah, upper-level wind shear increased and the system's outflow became restricted. As a result, Dinah steadily weakened.

Although Dinah began to weaken after 281200Z (Figure 3-11-3), it still had maximum sustained surface winds of 85 kt (44 m/sec) as it passed 90 nm (167 km) west of Kadena Air Base (Figure 3-11-4) at 291500Z. It caused considerable damage to U.S. military facilities on Okinawa. One person was killed and six people were injured. Trees were uprooted or broken off (Figure 3-11-5), utility poles and lines were blown down, and roofs and suffered structural damage. Total damage estimates to U.S. military facilities on Okinawa were in excess of $1.3 million. Maximum sustained surface winds on Okinawa were 63 kt (32 m/sec) with gusts from 98 to 106 kt (50 to 55 m/sec). Minimum sea-level pressure observed was 983 mb at 291755Z. By 300000Z, Dinah was located 120 nm (222 km) northwest of Okinawa with maximum sustained surface winds estimated to be 85 kt (44 m/sec). A ship passing 30 nm (56 km) northeast of Dinah's center at that time reported sustained winds of 75 kt (39 m/sec) from the southeast and a sea-level pressure of 938.7 mb.

Dinah began to recurve by 300000Z, assumed a north-northeasterly track and accelerated while still maintaining maximum sustained surface winds of 85 kt (44 m/sec). At 301700Z, Typhoon Dinah passed 60 nm (111 km) northwest of Sasebo Naval Base in western

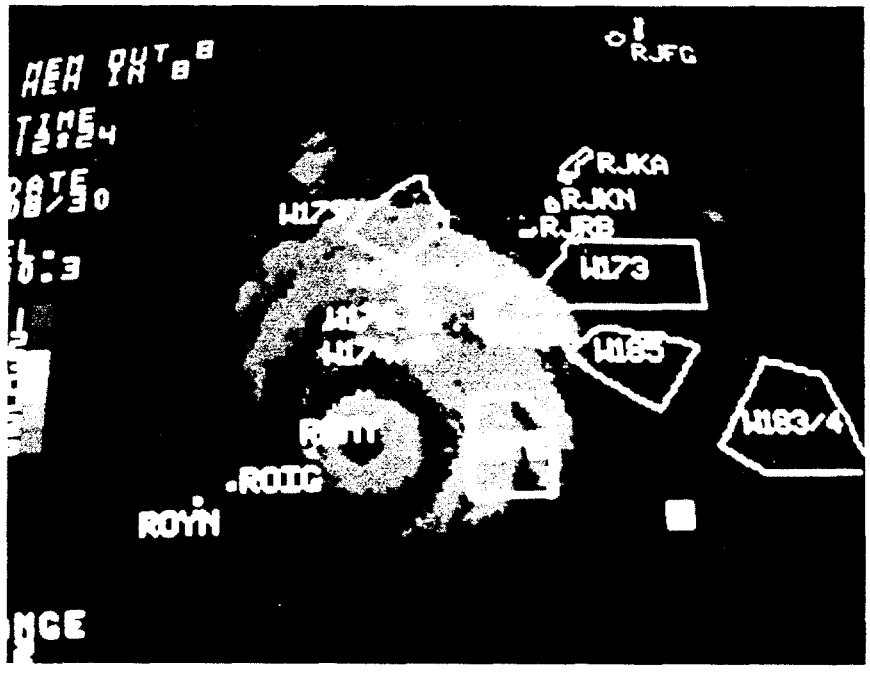


Figure 3-11-4. Radarscope photo of Dinah at 291224Z August (Photo courtesy of Detachment 8, 20 Weather Squadron, Kadena AB, Japan).

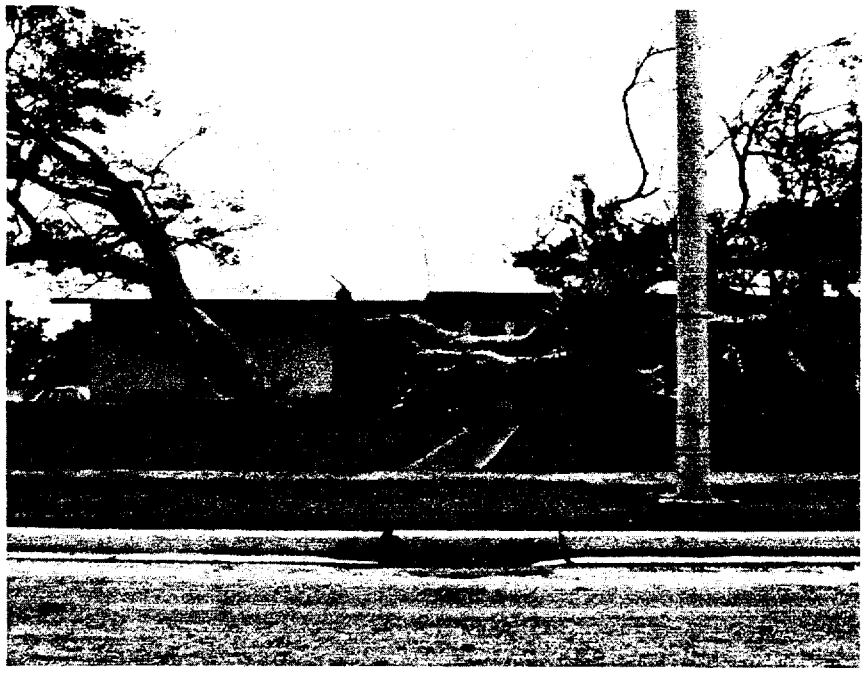
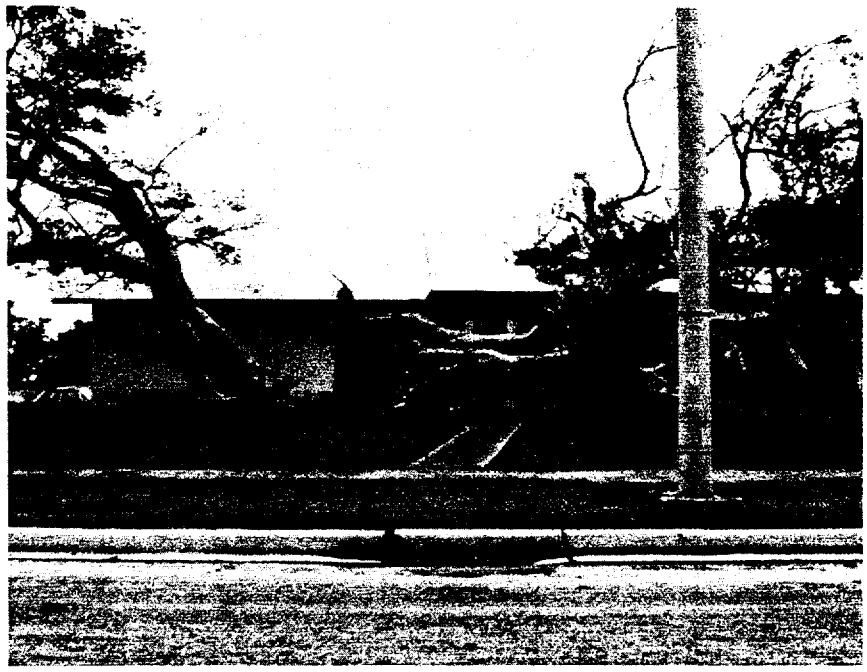


Figure 3-11-5. Trees on Okinawa were damaged and uprooted by the high winds associated with Dinah's passage (Photo courtesy of Detachment 8, 20 Weather Squadron, Kadena AB, Japan).

Japan where maximum sustained surface winds of 60 to 65 kt (31 to 33 m/sec) with gusts to 90 kt (46 m/sec) were observed. Extensive damage was caused by the storm surge and tidal action on seawalls and piers. A landing craft from the USS San Bernardino was destroyed when the seawall eroded and the pier collapsed. Damage also occurred to trees, utility lines and poles, and some building structures. Damage costs to the Japanese Sasebo Navy complex were in excess of $6.7 million, making Dinah the worst tropical cyclone to strike southwest Japan in recent history.

By 310000Z, Dinah was becoming extratropical as it began to merge with a mid-latitude frontal system that extended southwestward across the Sea of Japan. It was beneath the polar jet stream which had winds in excess of 90 kt (46 m/sec). Dinah was downgraded to a tropical storm as its convection sheared off to the northeast. The final warning was issued at 310600Z as the cyclone continued to accelerate toward the northeast at 33 kt (61 km/hr).

Throughout Dinah's life, JTWC consistently forecast recurvature and acceleration toward the northeast through the Sea of Japan. Forecast track errors were smaller than average. The dynamic aid OTCM performed extremely well during recurvature, while the objective aids Half Persistence and Climatology (HPAC) and climatology were used extensively as Dinah passed beneath the subtropical ridge.



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